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RESEARCH ARTICLE

The genus *Thalictrum* species as promising medicinal plants of the Tomsk region (Western Siberia)

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Abstract

The genus *Thalictrum species* (Ranunculaceae) are of interest for study as medicinal plants that are promising for expanding the gene pool and treating socially significant diseases. The data of the analysis of more than 100 geobotanical descriptions obtained in 2010-2017 were used to study the coenotic complexes of *Thalictrum minus* and *Thalictrum simplex* growing in Tomsk region and to determine their ecological-coenotic confinement. The aim of our research was to study the species of the genus *Thalictrum* growing in Tomsk region, their distribution and use in medicine, to investigate the coenotic complex, and to determine the ecological-coenotic confinement of *Thalictrum minus* L. and *Thalictrum simplex* L. growing in Tomsk region. The coenotic complex of *Thalictrum minus* includes 146 species. *Thalictrum minus* is the reserve of raw materials of Category II, which are identified in species confined to coenoses of different synanthropic degree, where they grow abundantly. The coenotic complex of *Thalictrum simplex* in Tomsk region includes 62 species. *Thalictrum simplex* is the reserve of raw materials of Category II.

Keywords

Thalictrum, medicinal plants, Tomsk region

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Introduction

The representatives of this genus are quite common in the Altai-Sayan province. In the "Synopsis of the flora of the northwestern part of the Altai-Sayan province", A.L. Ebel gives information on eight species of the genus *Thalictrum*: *Thalictrum alpinum* L., *Thalictrum appendiculatum* C.A. Mey, *Thalictrum flavum* L., *Thalictrum foetidum* L., *Thalictrum minus* L., *Thalictrum petaloideum* L., *Thalictrum schischkinii* Friesen, *Thalictrum simplex* L. Of these, four species are given for the Kolyvan-Tomsk fold zone: *Thalictrum appendiculatum*, *Thalictrum foetium*, *Thalictrum flavum*, *Thalictrum minus* (Ebel 2012).

The "Synopsis of the Flora of Siberia" provides information on 17 species and subspecies of the genus *Thalictrum*, of which two species are endemic: *Thalictrum alpinum* subsp. *udokanikum* Peschkova, an endemic of the Northern Baikal region, *Thalictrum minus* subsp. *pavlovii* (Reverd.) Friesen, an endemic of the Altai-Yenisei mountain hemiboreal province and the Baikal hemiboreal province (Malyshev et al. 2005).

In Tomsk region, five species of the genus *Thalictrum* grow: *Thalictrum sparsiflorum* Turcz. ex Fisch. et Meyer, *Thalictrum flavum* L., *Thalictrum foetidum* L., *Thalictrum simplex* L., *Thalictrum minus* L. (Ebel et al. 2014). Of these, *Thalictrum sparsiflorum*, which grows only in Bakcharsky and Verkhneketsky districts, is a rare species. In the monograph "Rare and Endangered Plants of the Tomsk Region," V.P. Amelchenko provides information on another species, *Thalictrum foetidum*, which requires further study as a rare species (Amelchenko 2010).

The *Thalictrum* biologically active substances include alkaloids, cyanogenic compounds, other nitrogen-containing compounds, triterpenoids, flavonoids, phytosterols, carbohydrates, pyrogallol tannins, essential oils, coumarins, polysaccharides, and organic acids. The therapeutic effect of *Thalictrum* species is diverse: vasodilator, coronary dilator, hypotensive, diuretic, antitumor, cytostatic (the aerial part of *Thalictrum foetidum*, *Thalictrum minus*). *Thalictrum* is used to treat diseases of the nervous system (epilepsy): the underground part of *Thalictrum flavum*, the aerial part of *Thalictrum minus*; *Thalictrum minus* is used to treat neuroses and diseases of the cardiovascular system. In the experiment, *Thalictrum minus* showed a sedative effect, *Thalictrum foetidum* exhibited anti-inflammatory and decongestant properties, and *Thalictrum flavum* displayed immunomodulatory properties (Budantsev et al. 2001).

Thalictrum minus L. is a perennial herb up to 140 cm high with large ternary leaves. *Thalictrum* flowers bloom in a multi-flowered panicle. The aerial part of Thalictrum minus contains alkaloids (thalmidine, thalmine, leucine), ascorbic acid, cyanoglycoside, flavone substances, bitterness, and phytoncides. Its aerial part is used in M.N. Zdrenko preparation to treat malignant tumors, gastric ulcers, and gastritis. *Thalictrum* alkaloids are used as a cardiovascular antihypertensive agent in cardiology. A phytochemical study of this species of *Thalictrum* growing in Siberia identified triterpene saponins, which exhibit a broad spectrum of medicinal action.

Their efficacy against tumors, cytotoxic and contraceptive effects, and the ability to regulate the level of some hormones was revealed (Mats et al. 1988, Rakhimov et al. 1987).

Thalictrum simplex L. is a promising source of isoquinoline alkaloids with analgesic, anti-inflammatory, hypotensive, and antitumor effect, which was used for highly effective medicinal preparations that have already been made or are under development (Yunusov 1997).

In the Southern Urals, natural populations of *Thalictrum minus* were studied using the cluster analysis based on the average sample values of morphological parameters of the plants. Six groups of local populations were identified. Scientists found out that the differences in local populations in terms of morphological parameters of plants do not depend on the geographical distance between populations but are affected by a complex of environmental factors that determine the characteristics of mountain forest, forest-steppe, and steppe habitats (Samoilova et al. 2011).

The genus *Thalictrum* was introduced in the Donetsk Botanical Garden. The study aimed to determine the state of the introduction and natural populations of *Thalictrum minus* in steppe communities, the indicator features of their ecological and demographic structure, which can reflect the state of modeled steppe phytocoenoses, and also natural populations at different stages of steppe succession. These studies will contribute to the protection of steppe phytocoenoses with *Thalictrum* (Ibatulina 2016).

Nowadays, the possibility of obtaining and using a suspension culture of *Thalictrum minus* L. of the strain Tm-2-05 VILAR as a promising source of raw materials for industrial production of berberine alkaloid has been experimentally established. This alkaloid exhibits antibacterial, antiprotozoal, and antifungal properties, and cytostatic activity. Berberine is an antioxidant with antispasmodic properties. It has a pronounced choleretic effect. *Berberis vulgaris* L. (Berberidaceae family) roots are used as the primary source of raw materials for producing the berberine alkaloid in Russia. Natural thickets of barberry cut down for collection of raw materials are restored after 10–20 years. Moreover, in industrial production, 40 kg of raw materials (roots) is required to produce about 200 g of berberine. The need for berberine based medicinal preparations is approximately 300 kg per year. This requires 60,000 kg of valuable shrub roots, which is difficult to harvest as the existing raw material base is rapidly declining and is under threat of extinction. Therefore, the problem of preserving this valuable shrub and finding alternative, economically viable sources of berberine is of current relevance. According to the authors, one of the alternatives and promising sources of berberine is the cell culture of *Thalictrum* (*Thalictrum minus* L.) of the family Ranunculaceae (Tertichnaya 2011).

We believe that it is much more promising to create introductory populations of this species, which do not require expensive biotechnology equipment to provide high-quality medicinal raw materials for the pharmaceutical industry.

Our research aimed to study the genus *Thalictrum* species growing in the Tomsk region, their distribution, and their use in medicine. We also used the data obtained

in our previous study into the coenotic complex and determination of the ecological-coenotic confinement of *Thalictrum minus* L., *Thalictrum simplex* L. growing in Tomsk region (Nekratova 2017).

Material and methods

The data of the analysis of more than 100 geobotanical descriptions obtained in 2010–2017 were used to study the coenotic complexes of *Thalictrum minus* and *Thalictrum simplex* growing in Tomsk region and to determine their ecological-coenotic confinement. A resource assessment was carried out, and a resource category was established according to the classification by N.A. Nekratova (Nekratova, Nekratov 2005). Natural resources of Category I include species that act as dominants or edifiers of indigenous coenoses or their succession series. Subject to the regime of rational exploitation, this group of species natural resources can serve as a reliable source of medicinal raw materials for large scale use. Natural resources of Category II were found in species confined to coenoses of different synanthropic degree, where they grow in increased abundance. Some species from this category are associated with indigenous coenoses and their succession series. In general, medicinal plants of this group are an additional medicinal raw material source for smaller scale use. Category III includes species that are not widely distributed in a given territory with sparse populations due to their biological characteristics. It also includes species that are quite rare in this region for historical reasons and due to modern natural conditions. Category IV includes species that are scanty in a given territory; harvesting of these species for raw materials in this region is unacceptable. A limited collection of seeds may be permitted. Species of Category III and IV are non-commercial.

Results

The coenotic complex of *Thalictrum minus* includes 146 species; it grows in mixed birch-aspen, aspen-birch, pine forests, and in floodplain herb-grass meadows. The predominant species of the coenotic complex are *Aegopodium podagraria* L., *Calamagrostis langsdorffii* (Link) Trin., *Carex macroura* Meinsh., *Chamaenerion angustifolium* (L.) Scop., *Equisetum arvense* L., *Heracleum dissectum* Ledeb., and *Pteridium aquilinum* (L.) Kuhn. The associated species are: *Achillea millefolium* L., *Aconitum septentrionale* Koelle, *Elytrigia repens* (L.) Nevski , *Alopecurus pratensis* L., *Arctium lappa* L. and *Artemisia vulgaris* L. The tree layer is dominated by *Betula pendula* Roth, *Populus tremula* L., and *Pinus sylvestris* L. The projective cover is from 1% to 60%. *Thalictrum minus* has the raw material reserves of Category II that are found in species confined to coenoses of different synanthropic degree, where they grow in increased abundance.

The occurrence of species in these phytocoenoses and their abundance are shown based on data obtained in the analysis of geobotanical descriptions in communities with *Thalictrum minus* in Tomsk region.

The coenotic complex of *Thalictrum simplex* in the Tomsk region numbers 62 species; it grows in aspen forb forests, on floodplain forb-grass, forb-fern, and forb-wheatgrass meadows. The predominant species of the coenotic complex are: *Aegopodium podagraria* L., *Agropyron repens* (L.) P. Beauv. , *Calamagrostis obtusata* Trin., *Fragaria vesca* L., *Pteridium aquilinum* (L.) Kuhn. The associated species are *Achillea millefolium* L., *Angelica sylvestris* L., *Artemisia vulgaris* L., *Carum carvi* L., and *Equisetum pratense* Ehrh. *Populus tremula* L. prevails in the tree layer. The projective cover is from 1% to 30%. *Thalictrum simplex* has the raw material reserves of Category II.

Conclusion

Thus, representatives of the *Thalictrum* genus are valuable medicinal plants used to treat socially significant diseases. These species need further study as sources of biologically valuable substances to provide the pharmaceutical industry with new effective medicine. The coenotic complex of *Thalictrum minus* includes 146 species. *Thalictrum minus* has the raw material reserves of Category II that are found in species confined to coenoses of different synanthropic degree, where they grow in increased abundance. The coenotic complex of *Thalictrum simplex* in Tomsk region includes 62 species. *Thalictrum simplex* has the raw material reserves of Category II.

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